UNITED SPA CONTROLS™

C5 Series

Installation & Service Manual

For C5 Series Controls with the B8 Circuit Board

Revision 10.13

End User Disclaimer

End User Disclaimer:

United Spa Controls systems have absolutely no end user serviceable parts. United Spa Controls does not authorize attempts by the spa owner/user to install or repair/service any United Spa Controls products.

Non-qualified users should never open or remove covers, as this will expose dangerous voltage points and other serious risks.

Non-qualified users should not attempt to make changes to the topside's programming, as mis-programming can result in malfunction or possible damage.

Please contact your dealer or a locally licensed service center for service and technical support.

This installation and service manual is provided solely to aid qualified spa service technicians in installing, setting up, and troubleshooting spas with United Spa Controls systems.

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Electrical Installations

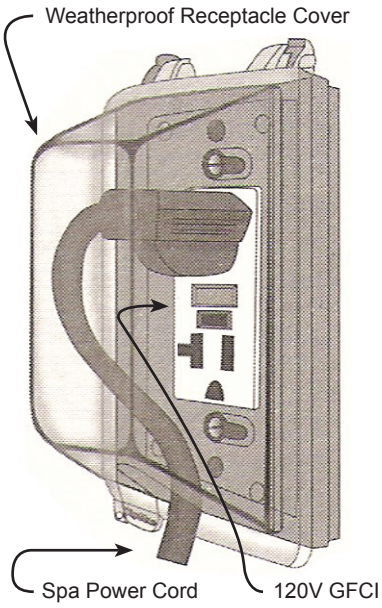
120V Installation (Cord and Plug Connected Units):
Equipment Modules provided with a factory installed power cord are to be plugged into a grounding type, 120 volt, receptacle.

The connection of the plug to a 240 volt service will cause the Equipment Module to operate improperly, create the potential for an electrical hazard, and will void the warranty.

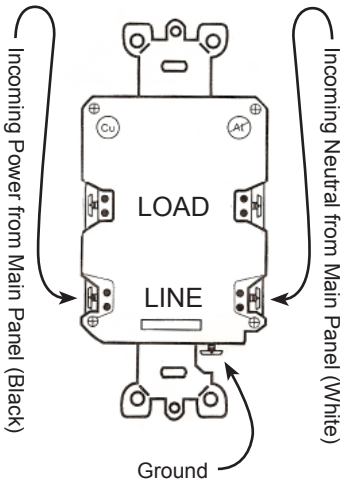
The electrical supply for cord and plug connected units must include a suitably rated Ground Fault Circuit Interrupter (GFCI) in compliance with Article 680-42 of the National Electrical Code. ANSI/NFP70. No other electrical appliance or fixture should be used on this circuit.

- Use only dedicated electrical line with 20 amp breaker.
- Do not use an extension cord.
- Always use a weatherproof covered receptacle.
- Do not bury the power cord.

Weather Proof GFCI Kit



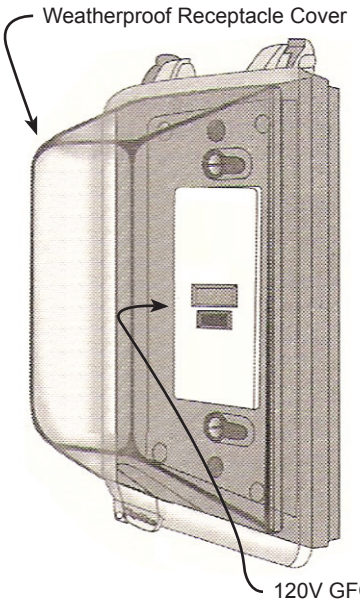
Back View



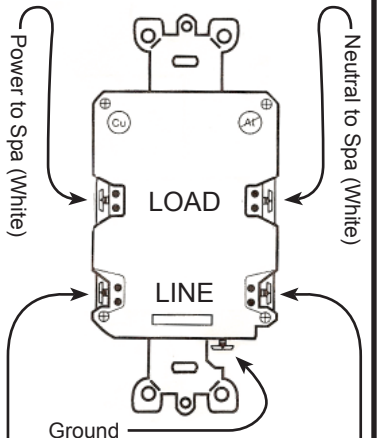
120V Installation (Permanently Connected Units):
Units to be operated at 120 volt must have all electrical connections accomplished by a qualified electrician in accordance with the National Electrical Code or the Canadian Electrical Code, and other electrical codes at the time of installation. All connections must be made with copper conductors. The conductors and circuit breaker must be sized to accommodate the total amperage load as specified on the Equipment Module data label. Equipment Modules installed for 120 volt operation require a two wire electrical service, plus ground. Line 1 (black), Neutral (white), and Ground (green).

The disconnecting means must be readily accessible to the tub occupant but installed at least 5 feet (1.5 m) from tub water. The electrical supply for permanently connected units must include a suitably rated Ground Fault Circuit Interrupter (GFCI) in compliance with Article 680-42 of the National Electrical Code. ANSI/NFP70. No other electrical appliance or fixture should be used on this circuit.

Weather Proof GFCI Kit



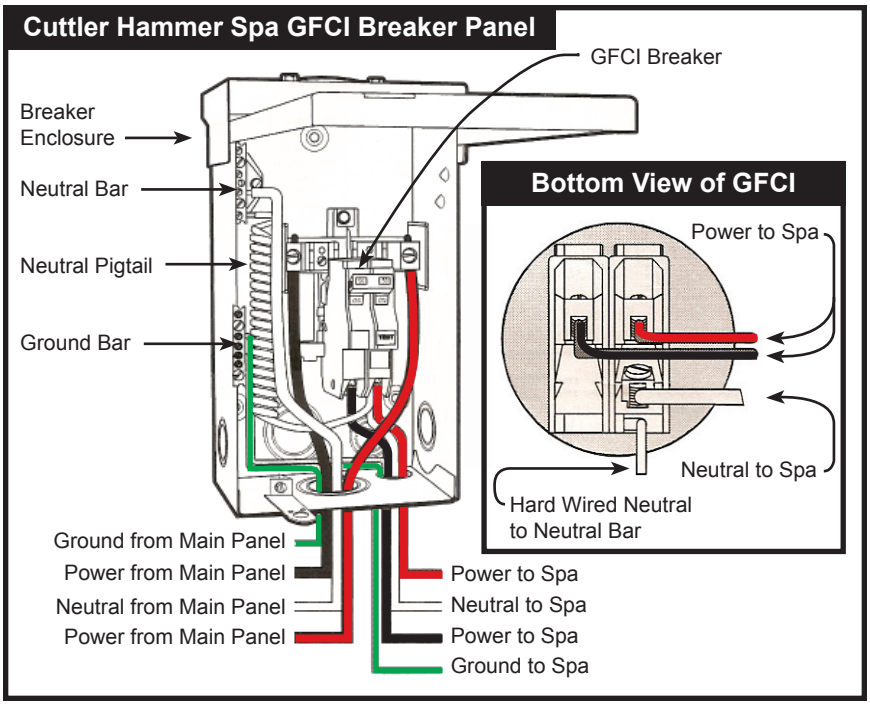
Back View



Electrical Installations

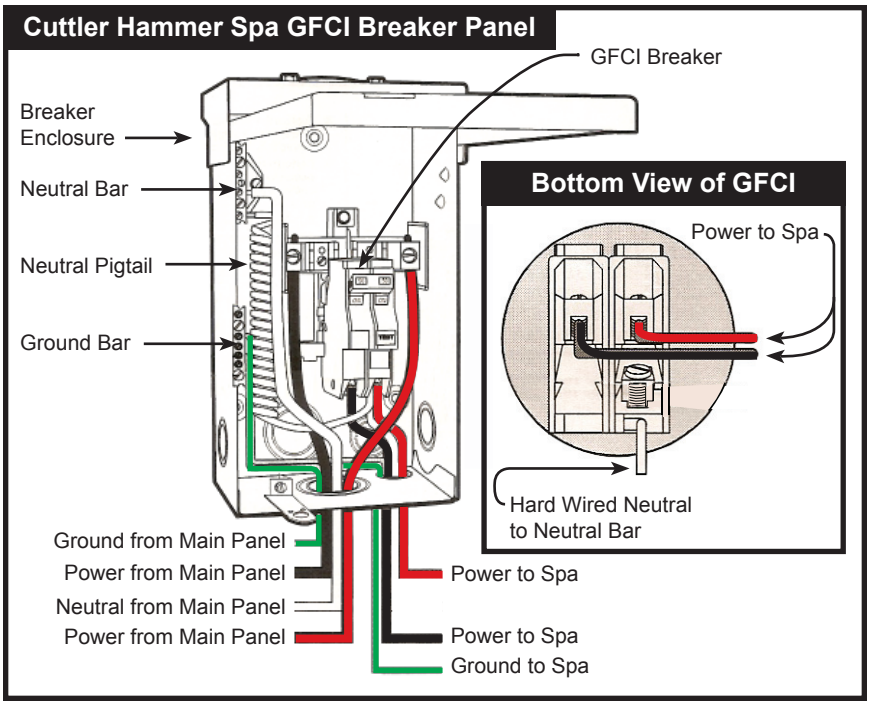
240V Installation (4 wire - Line 1, Line 2, Neutral, and Ground):
Units to be operated at 240 volt must have all electrical connections accomplished by a qualified electrician in accordance with the National Electrical Code or the Canadian Electrical Code, and other electrical codes at the time of installation. All connections must be made with copper conductors. The conductors and circuit breaker must be sized to accommodate the total amperage load as specified on the Equipment Module data label. Equipment Modules installed for 240 volt operation require a three wire electrical service, plus ground. Line 1 (black), Line 2 (red), Neutral (white), and Ground (green).

The disconnecting means must be readily accessible to the tub occupant but installed at least 5 feet (1.5 m) from tub water. The electrical supply for permanently connected units must include a suitably rated Ground Fault Circuit Interrupter (GFCI) in compliance with Article 680-42 of the National Electrical Code. ANSI/NFP70. No other electrical appliance or fixture should be used on this circuit.



240V Installation (3 wire - Line 1, Line 2, and Ground):
Units to be operated at 240 volt must have all electrical connections accomplished by a qualified electrician in accordance with the National Electrical Code or the Canadian Electrical Code, and other electrical codes at the time of installation. All connections must be made with copper conductors. The conductors and circuit breaker must be sized to accommodate the total amperage load as specified on the Equipment Module data label. Equipment Modules installed for 240 volt operation require a two wire electrical service, plus ground. Line 1 (black), Line 2 (red), and Ground (green).

The disconnecting means must be readily accessible to the tub occupant but installed at least 5 feet (1.5 m) from tub water. The electrical supply for permanently connected units must include a suitably rated Ground Fault Circuit Interrupter (GFCI) in compliance with Article 680-42 of the National Electrical Code. ANSI/NFP70. No other electrical appliance or fixture should be used on this circuit.



Control Box Installation

Mounting and Plumbing Considerations

The C5 control box is made for above ground portable hot tubs. As such it is an indoor unit, meant to be mounted inside of the portable hot tub's enclosure. Water may flow through the heater in either direction, as long as the water is being pushed through it (plumbed up to the discharge of the pump). Plumbing the heater up to the suction of the pump will not allow the heater to operate.

Temperature Sensor Installation

The C5 control box comes with a 1/4" diameter temperature sensor. Its probe is meant to be installed into a thermowell which itself should be installed mid-water level in the hot tub to provide the most accurate temperature reading. After installing the temperature sensor probe, be sure to plug the connector on the end of the cable into the temperature sensor receptacle on the control box. The included sensor is carefully calibrated to it's cable's length, and therefore must in no way be altered or shortened/lengthened.

Equipment Connection

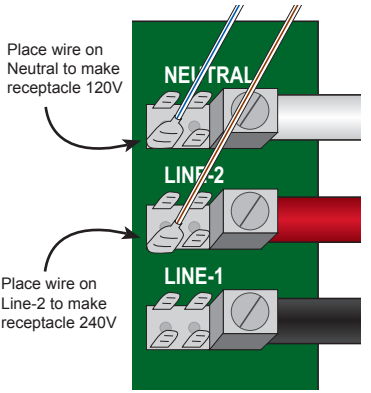
The **Circulation Pump** receptacle is for circulation pumps (rated 2A or less). If your pump does not match this description it must be connected to the **Pump-1** receptacle and used as Pump-1. See page 11 for an important note on how to wire the Circulation Pump cord for timed operation!

The C5 control uses the red wire for low-speed operation of Pump-1 and Pump-2. Connecting a single speed pump as Pump-1 for both operating the jets and heating/filtration is not recommended, but if you must use a single speed pump for both, you must connect the red and black wires of the pump cable together up to the high speed terminal on the back of the pump's motor to both operate jets and heat/filter.

If you are connecting an air blower or third pump to the **Auxiliary** receptacle, then if there is a two speed Pump-2 it *must* be wired for single speed (no red wire) operation at the back of the motor.

The **Pump-1** and **Pump-2** receptacles are pre-wired for 240V. The **Ozone**, **Circulation Pump**, **Auxiliary**, **Audio,** and **Gas** (on the C5-G) receptacles are all pre-wired for 120V.

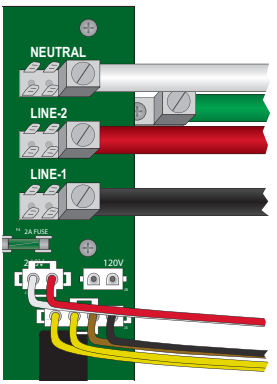
These receptacles are all dyed different colors, and have white wires striped with their respective receptacle's color. To change the voltage of a receptacle simply move it's correspondingly color striped white wire at the power lugs from Neutral to Line 2 to convert to 240V, or from Line 2 to Neutral to convert to 120V.



The **Light** receptacle is wired for industry standard 12V lighting, up to 0.9A.

Power Installation

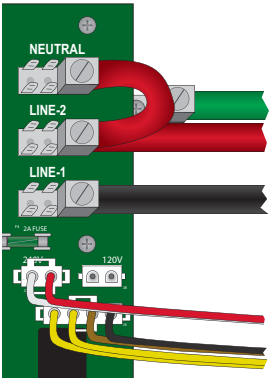
For 4-wire 240V power installations: As shown, the included dual-voltage transformer's 2-pin AMP plug needs to be connected to the board's 240V receptacle. The incoming Line-1, Line-2, and Neutral wires will need to be connected to the correspondingly labeled power lugs on the circuit board. The ground wire will need to be connected to the ground lug that is fastened to the aluminum enclosure.



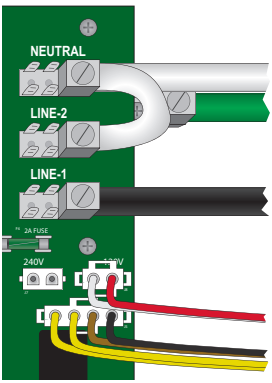
See the following page for information on 3-wire 240V and 120V power installations...

Control Box Installation

For 3-wire 240V power installations:
As shown, the included dual-voltage transformer's 2-pin AMP plug needs to be connected to the board's 240V receptacle. The incoming Line-1 and Line-2 wires will need to be connected to the correspondingly labeled power lugs on the circuit board. The incoming Line 2 will also need to be brought to the Neutral power lug (commonly done with a short jumper wire as illustrated). The ground wire will need to be connected to the ground lug that is fastened to the aluminum enclosure.



For 120V power installations:
As shown, the included dual-voltage transformer's 2-pin AMP plug needs to be connected to the board's 120V receptacle. The incoming Line-1 and Neutral wires will need to be connected to the correspondingly labeled power lugs on the circuit board, and the incoming Neutral will also need to be brought to the Line 2 power lug on the circuit board (commonly done with a short jumper wire as illustrated). The ground wire will need to be connected to the ground lug that is fastened to the aluminum enclosure.



Finishing Installation

After installation of the C5 control box is complete, its time to read through the installation manual and user's guide booklet that comes packaged with the topside control. The installation manual will guid you through installing and programming the topside which completes the installation process.

Important Troubleshooting Information

Warning:

When working on the control box be aware that it may contain high voltage wiring.

Warning:

Always keep your fingers and tools away from the circuit board and any wiring while the power is on. Serious injury may result!

Warning:

Make sure that the power to the control box is shut off before touching any wiring.

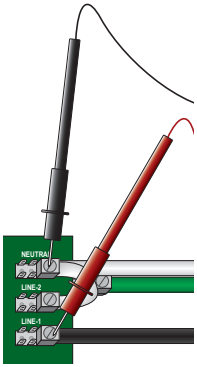
When troubleshooting a United Spa Controls system, no matter how minor the issue is, the first things that must be checked are the incoming power to the control board and the output power of the transformer.

You will need to set your multi-meter or voltmeter for AC Volts when testing voltages within the United Spa Controls system. You will only set your multi-meter or voltmeter to DC Volts when testing the IC Regulator Chip.

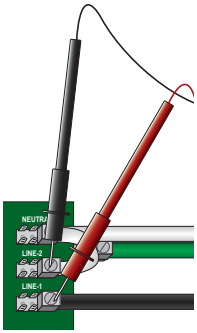
Once you've completed the incoming voltage and transformer voltage checks as outlined on the next few pages, you can proceed with further diagnosis using the test points and instructions outlined later in this section.

Incoming Voltage Checks

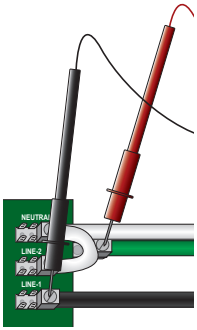
Voltage Check for 120V Incoming Power:



Neutral and Line-1
120VAC (108VAC-132VAC)



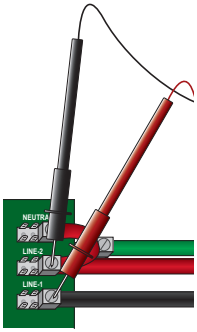
Line-2 and Line-1
120VAC (108VAC-132VAC)



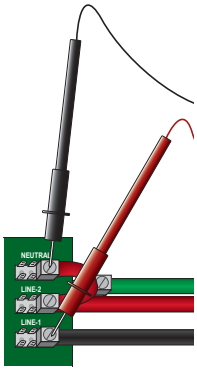
Line-1 and Ground
120VAC (108VAC-132VAC)

120VAC (Range of acceptability: 108VAC to 132VAC) should be read between; Neutral and Line-1, Line-2 and Neutral, and Line-1 and Ground.

Voltage Check for 240V (3-Wire) Incoming Power



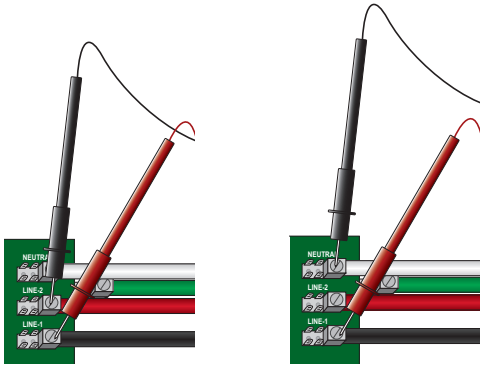
Line-2 and Line-1
240VAC (216VAC-264VAC)



Neutral and Line-1
240VAC (216VAC-264VAC)

240VAC (Range of acceptability: 216VAC to 264VAC) should be read between Line-2 and Line-1, and between Neutral and Line-1.

Voltage Check for 240V (4-Wire) Incoming Power



Line-2 and Line-1
240VAC (216VAC-264VAC)

Neutral and Line-1
120VAC (108VAC-132VAC)

240VAC (Range of acceptability: 216VAC to 264VAC) should be read between Line-2 and Line-1. 120VAC (Range of acceptability: 108VAC to 132VAC) should be read between Neutral and Line-1.

If ANY of the voltages read when checking the incoming power do not fall within the indicated ranges of acceptability, then do not proceed with any further troubleshooting until the incoming power issue is corrected.

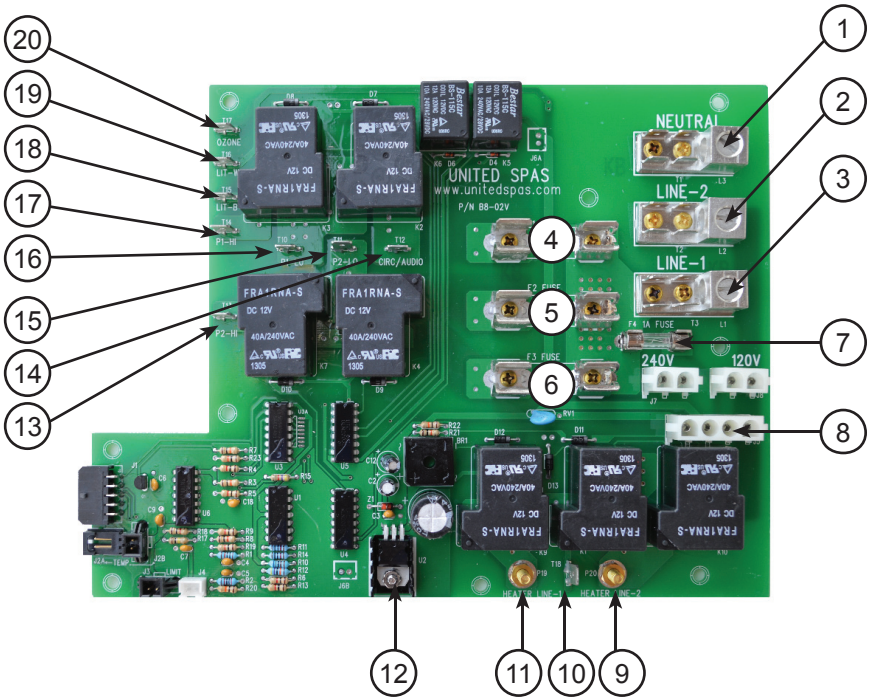
Further Troubleshooting

If the system passes the incoming voltage check, the transformer and the circuit boards's glass fuse should be tested next. By testing the incoming voltage, and the power to the board (the transformer, and glass fuse), you can proceed with further troubleshooting without possibly missing an underlying power related problem.

The Troubleshooting Test Points outlined on the next page will be referenced throughout the rest of this section in explaining how to test the various internal circuits of the control box. The page after next will explain how to properly test the transformer and circuit board's glass fuse. The pages that follow that will explaining trouble shooting the other various circuits of the control box.

Troubleshooting Test Points

The following test points will be used when troubleshooting the control box's internal circuits:



1 - Incoming Neutral
2 - Incoming Line-2
3 - Incoming Line-1
4 - 20A Fuse (F1)
5 - 20A Fuse (F2)
6 - 20A Fuse (F3)
7 - 2A Glass Fuse (F4)
8 - Transformer Receptacle
9 - Heater Line-2
10 - T18/Gas Terminal
11 - Heater Line-1
12 - IC Regulator Chip
13 - Pump-2 Hi-Speed Power
14 - 24Hr Circ & Audio Power
15 - Aux/Pump-2 Lo-Speed Power
16 - Pump-1 Lo-Speed/Timed Circ Power
17 - Pump-1 Hi-Speed Power
18 - Light (black wire)
19 - Light (white wire)
20 - Ozone Power

Transformer Voltage Checks

The dual-voltage transformers used in United Spa Controls systems have 6 wires, and two plugs. There is a 2-prong AMP plug with a red and white wire, that determines the transformer's input voltage by being plugged into the board's labeled receptacle corresponding to the incoming power supply (120V or 240V). There is also a 4-pin AMP plug, with the a black, a brown wires, and two yellow power wires that carry the voltage to and from the board. It should be possible to slide the pins of your voltmeter/ multi-meter into the top of the 4-pin transformer plug (where the power wires enter the 4-pin AMP plug). 240VAC (Range of acceptability: 216VAC to 264VAC) should be read between the black and brown wires when the 2-pin AMP plug is plugged into the 240V receptacle, or 120VAC (Range of acceptability: 108VAC to 132VAC) when the 2-pin AMP plug is plugged into the 120V receptacle. If you are not getting a reading of the incoming power within the acceptable range, and you've confirmed the incoming voltage with the previous voltage checks, then the 2A Glass Fuse (Testing Point 7) should be checked next.

If the incoming voltage checks out, proceed to test the output voltage. 12VAC (Range of acceptability: 12VAC to 14VAC) should be read between yellow wires. If the voltage read between the yellow wires does not fall within the indicated ranges of acceptability, then do not proceed with any further troubleshooting until the transformer has been replaced.

Checking the 2A Glass Fuse

Put one probe of your voltmeter/multi-meter on Line-2 (Testing Point 2), and the other on the RIGHT fuse clip of the 2A Glass Fuse (Testing Point 7). You should get a voltage reading equal to the control box's incoming power voltage (240VAC or 120VAC). Leaving one probe on Line-2, move the other probe to the LEFT fuse clip. You should again get a voltage reading equal to the incoming power voltage, if you do not, then the fuse has blown and needs replacing.

Troubleshooting the Circuit Board's Low Voltage Circuit

If the control is non-operational, or the topside display is completely blank, but the incoming voltage, transformer, and glass fuse all test okay, the circuit board's IC Regulator Chip should be tested.

Checking the IC Regulator Chip

Be sure your voltmeter/multi-meter is set to DC Volts to test this component. Place one probe of your voltmeter/multi-meter on the IC Regulator Chip's (Testing Point 12) mounting nut, and the other on the RIGHT most pin coming out of the top of the chip. You should get a voltage reading of approximately 15VDC. If not, the board's bridge rectifier (marked BR1 on the board) has failed and needs to be replaced.

Next, leaving one probe on the mounting nut, move the other probe to the LEFT most pin coming out of the top of the chip. You should get a voltage reading of approximately 5VDC. If not, the IC Regulator Chip itself has failed and needs to be replaced.

Troubleshooting the Light Circuit

With the light turned on at the topside, place one probe of your voltmeter/multi-meter on Testing Point 18 (Light-B) and the other on Testing Point 19 (Light-W). You should get a reading of 12VAC. If you read no voltage, and the incoming power and transformer tested okay, then the light relay has failed. If you read voltage, but the light does not function, then the light bulb itself has failed and needs replacing.

Troubleshooting the Pumps/Blower/Ozone

If one or more of the pumps/blower/ozone are non-operational, re-check that the code settings have been programmed correctly for the equipment configuration. If programmed correctly, the main fuses and output voltages should be checked.

Checking the Main Fuses

On the B7 board, the Circulation Pump, Pump-1, Audio, and ozone all use the F1 Fuse (Testing Point 4). The Blower, Pump-3, or Pump-2 (Low-Speed) uses the F2 Fuse (Testing Point 5)., while Pump-2 (Hi-Speed) uses the F3 Fuse (Testing Point 6). Check the fuse of the non-operational component by putting one probe of your voltmeter/multi-meter on Line-2 (Testing Point 2) and the other on the RIGHT fuse clip of the fuse in question. You should get a voltage reading equal to the control box's incoming power voltage (240VAC or 120VAC). Leaving one probe on Line-2, move the other probe to the LEFT fuse clip. You should again get a voltage reading equal to the incoming power voltage, if you do not, then the fuse has blown and needs replacing.

Checking the Output Voltages

The output power pin of each component are located at the top left of the circuit board (Testing Points 13-17, and 20). To test, activate the desired component that is being tested. Pump-1, Pump-2, and Aux can be activated by simply pressing their corresponding button on the topside. The ozonator is only activated during filtration cycles, so you'll have to force the system to filter to test the ozone power. Activation is not necessary for 24hr Circ pump or Audio as these components are constantly powered. Next place one probe of your voltmeter/multi-meter on Line-2 (Testing Point 2), and the other on the testing point for the component in question. If the fuse checks out, but no voltage is read on the power terminal of the component in question (while the control is of course calling for that component to run), then the relay for that component has failed.

Troubleshooting the Heating Circuit

If the heater is non-operational or the unit is not heating properly, re-check that the code settings have been programmed correctly for the hot tub's heating configuration. If programmed correctly, the heating circuit should be tested.

Testing the Heating Element

To test the heating element, you must first make sure the topside is calling for heat (The display should be flashing the heat message - HEt). Then place one probe of your voltmeter/multi-meter on Testing Point 11 (Heater Line-1), and the other on Testing Point 9 (Heater Line-2). You should get a voltage reading equal to the control box's incoming power voltage (240VAC or 120VAC). If that is the case, but the water is not getting heated, then the heating element has failed/burnt-out/dry-fired.

If the voltage reading was not equal to the incoming power voltage, then proceed with checking the heater relays.

Testing the Heating Relays

Place one probe of your voltmeter/multi-meter on Line-1 (Test Point 1), and the other on Test Point 9 (Heater Line-2). You should get a voltage reading equal to the control box's incoming power voltage (240VAC or 120VAC). If that is the case, proceed to the next test. If you read no voltage, however, then the K10 relay has failed.

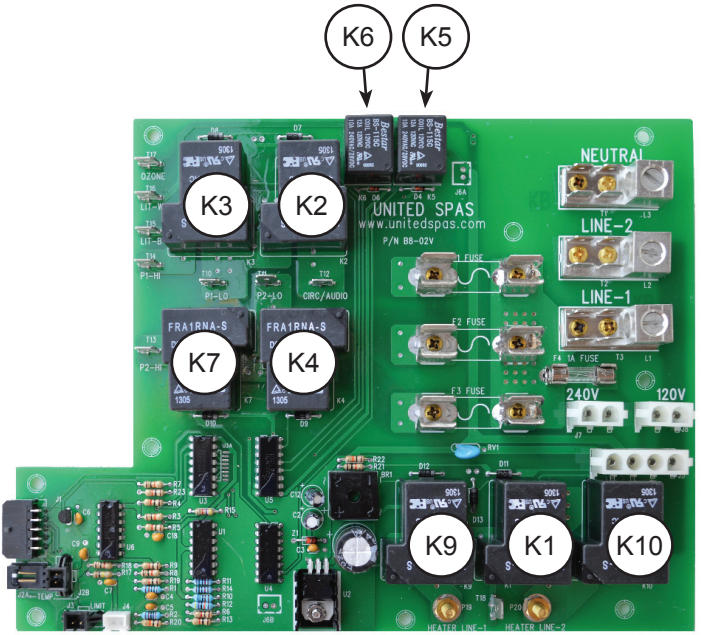
If the K10 relay checks out, place one probe of your voltmeter/multi-meter on Line 2 (Test Point 2) and the other on Test Point 10 (T18/Gas Terminal). You should get a voltage reading equal to the control box's incoming power voltage (240VAC or 120VAC). If that is the case, proceed to the next test. If you read no voltage, however, then the K1 relay has failed.

If the K1 relay checks out, place one probe of your voltmeter/multi-meter on Line 2 (Test Point 2) and the other on Test Point 11 (Heater Line-1). You should get a voltage reading equal to the control box's incoming power voltage (240VAC or 120VAC). If you read no voltage, then the K9 relay has failed.

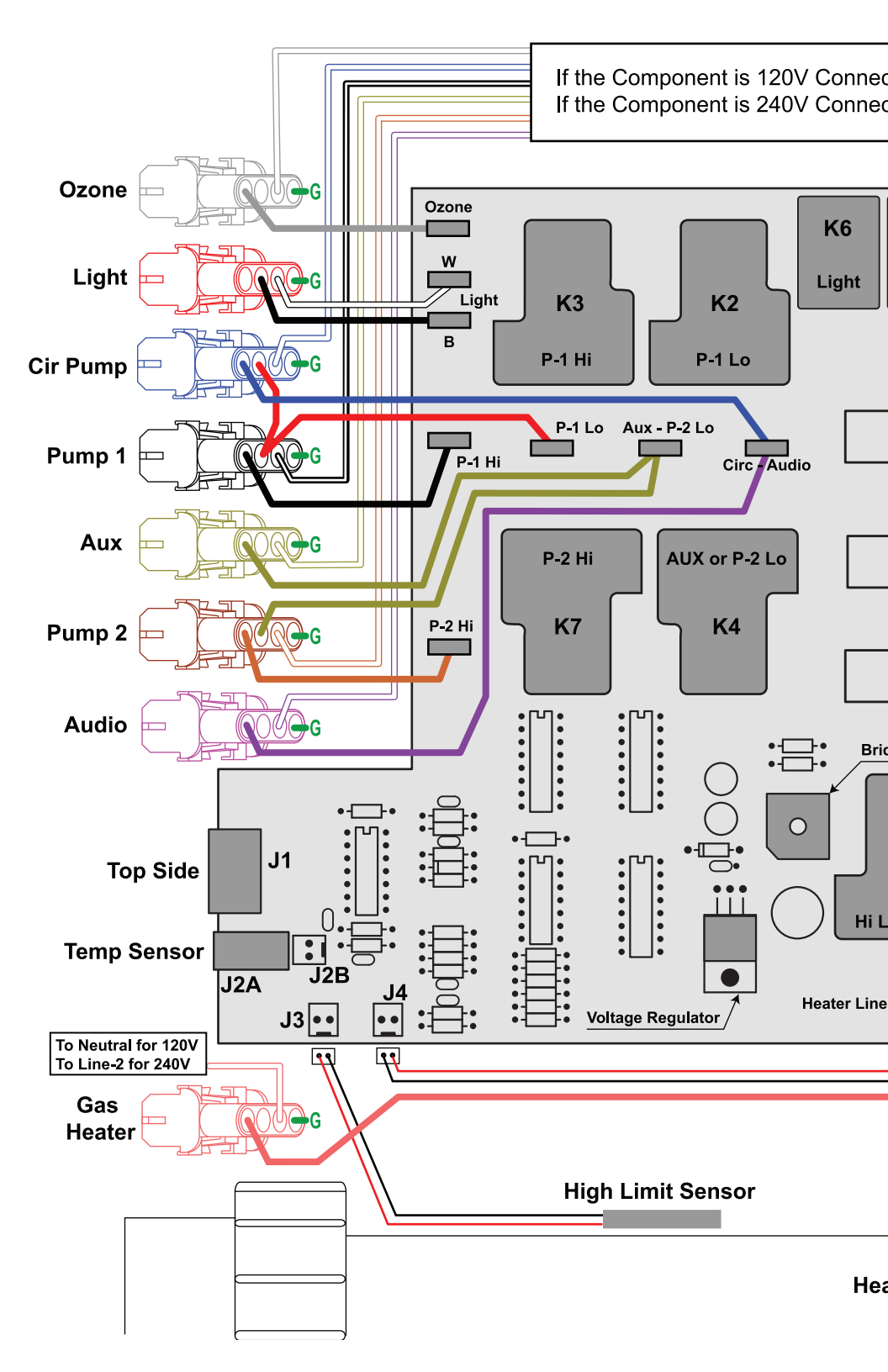
Replacing Relays

Should a relay fail, it can be replaced by anyone qualified to solder or work on electronics. Replacement relays should be available from anywhere United Spa Controls products are sold.

Relay Locations



K1 - Temp Relay
K2 - Pump-1 Lo-Speed Relay
K3 - Pump-1 Hi-Speed Relay
K4 - Pump-2 Low & Aux Relay
K5 - Ozone Relay
K6 - Light Relay
K7 - Pump-2 Hi-Speed Relay
K9 - Hi-Limit-L1 Relay
K10 - Hi-Limit-L2 Relay


If the Component is 120V Connec
If the Component is 240V Connec
Ozone
Light
Cir Pump
Pump 1
Aux
Pump 2
Audio
G
Ozone
W
Light
B
K3
P-1 Hi
K2
P-1 Lo
K6
Light
P-1 Lo
Aux - P-2 Lo
Circ - Audio
P-1 Hi
P-2 Hi
K7
AUX or P-2 Lo
K4
P-2 Hi
Top Side
J1
Temp Sensor
J2A
J2B
J3
J4
Voltage Regulator
Heater Line
To Neutral for 120V
To Line-2 for 240V
Gas
Heater
High Limit Sensor

ct it's Common Line to the Neutral Lug
ct it's Common Line to the Line-2 Lug

K5
Ozone

Neutral

Line-2

Line-1

P-1 FUSE

P-2 FUSE

P-3 FUSE

2A FUSE

240V
J7

120V
J8

12V HV
J5

dge Rectifier

K9
imit L-1

K1
Temp

K10
Hi Limit L-2

Gas Heater Power Line

-1

Heater Line-2

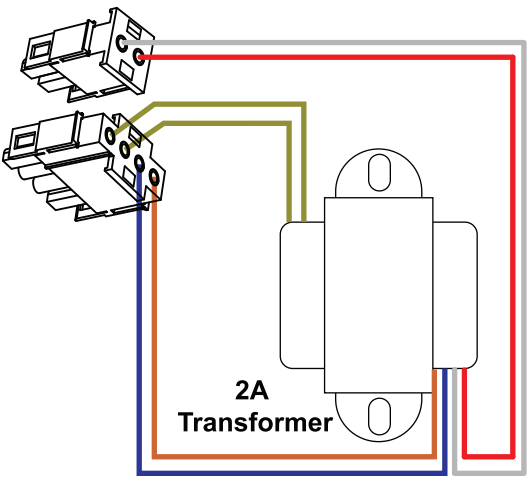
N G L2 L1
240V 4 WIRES

Ground

L2 G L2 L1
240V 3 WIRES

N G N L1
120V 3 WIRES

¤ USE COPPER CONDUCTORS ONLY
¤ EMPLOYER UNIQUEMENT DES CONDUCTEURS DE CUIVRE



Pressure Switch

ater Unit

C5 Series Specs

Environmental	
Operational Temperature	-0°F (-18°C) to 145°F (62°C)
Storage Temperature	-2°F (-19°C) to 175°F (79°C)
Humidity	Up to 80% RH, non condensing
Mechanical	
Weight (without topside/cable)	
C5-B	7.50 lbs. (3.40 kg)
C5-T	8.15 lbs. (3.70 kg)
C5-L	8.00 lbs. (3.63 kg)
C5-G	5.50 lbs. (2.49 kg)
C5-R	9.00 lbs. (4.08 kg)
Dimensions (without tail peices)	
C5-B	11.25”H x 15.50”W x 3.25”D
C5-T	13.00”H x 15.50”W x 6.00”D
C5-L	11.25”H x 20.50”W x 6.50”D
C5-G	11.25”H x 12.75”W x 3.00”D
C5-R	11.25”H x 12.75”W x 3.00”D
C5-R Heater	6.00”H x 15.50” x 3.25”D
Dimensions (mounting holes)	13.25” x 2.63”
Enclosure	
Control Box	Aluminum
Heater (No heater on C5-G)	Stainless Steel
Certifications	
ETL Listed (USA & Canada - File: 119733)	UL STD 1563 - 5th Edition CSA C22.2 NO. 218.1
Minimum Heater Flow	
C5-B, C5-T, C5-R	25 GPM Minumum
C5-L	15 GPM Minumum
C5-G	N/A
Electrical	
Incoming Power	120V/240V 50/60Hz
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Ozone	240V/120V - 1A
Light	12V - .9A
Circulation Pump	240V/120V - 2A
Pump-1	240V/120V - 12A
Aux	240V/120V - 12A
Pump-2	240V/120V - 12A
Audio	240V/120V - 4A
Gas Heater (C5-G only)	120V/240V - 1A

United Spa Controls One Year Limited Warranty

United Spa Controls warrants, to the original purchaser, the Spa Control Equipment against defects in materials or workmanship for a period of one year from date of purchase. The obligation of this warranty shall be limited to repairing or replacing the part, which in the opinion of the company shall be proved defective in materials or workmanship. This limited warranty does not include the limitations described below.

Limitations of Coverage: This warranty does not cover failures due to: damage, freezing, power failure, power reduction, unusual atmospheric conditions, rust or corrosion, repairs necessary because of operator negligence improper re-packaging and damage incurred in shipping. This warranty does not cover thermostat calibration, plumbing, expendable items (gaskets, o-rings, filter cartridges).

Acts Invalidating Warranty: This warranty shall be invalid if this equipment has been subjected to alterations, misuses or abuse, improper water chemistry maintenance or used for commercial purposes (used in other than single family household purposes). Misuse and abuse shall include application installation or operation outside of the environment and limitations for which it was designed, or other than in accordance with United Spa Controls or the spa manufacturer printed instructions. This warranty shall also be invalid if the spa equipment is damaged by earth or ground fill movement, fire, flood, wind, lightning, by Act of God, accident, or by intentional, reckless, or negligent acts any person.

Warranty Performance: All warranty service and/or replacement of parts must be performed by an individual or service company that has been authorized by United Spa Controls. The purchaser may obtain the benefits of warranty coverage on a failed part by having the servicing company remove the part and send it for inspection, along with proof of purchase and field service report, freight pre-paid, to: United Spa Controls 2480-B N. Glassell St., Orange, CA 92865 If the failure is covered by the warranty, there will be no charge for the repaired or replacement part. Removal charges, re-installation charges, and freight charges to and from United Spa Controls of the failed part shall be the purchaser's responsibility. Any such warranty replacement or repair shall be subject to the terms and condition of this warranty for the remainder of the original period of coverage. United Spa Controls reserves the right to inspect the malfunction or defect on location.

Disclaimers, Legal Remedies: United Spa Controls shall not be liable for the loss of use of any equipment. This warranty is in lieu of all other expressed warranties obligations or liabilities, any implied warranty of merchantability, shall be limited in duration to the duration of this written limited warranty. Any action for breach of warranty hereunder, including but not limited to, any applied warranty of merchantability must be brought within a period of 12 months from date of purchase. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. No agent, representative, dealer or employee of the company has the authority to increase or alter the obligations of this warranty. In no case shall the company be liable for any incidental or consequential from state to state. United Spa Controls does not authorize any person or company to assume for it any other obligation or liability in connection with the sale, application, engineering, damages for breach of this of any other warranty, expressed or implied, whatsoever. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary installation use, removal, return, or replacement of it's systems: and no such representations are binding on United Spa Controls.

United Spa Controls
2480-A N. Glassell St.
Orange, CA 92865

Web: UnitedSpaControls.com
E-mail: info@unitedspacontrols.com
Phone: 714-282-1117
Fax: 714-282-8684

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